

# GIS and Spatial Mapping of Single Family Housing Estates in Port Harcourt Urban Fringes

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## Abstract

This article provides a spatial analytical framework for using Geographic Information Systems (GIS) technology in housing research. It examines the spatial mapping of single family housing estates in Port Harcourt Urban fringes and discusses how GIS can aid with empirical research investigations. GIS, coupled with spatial analytical tools, offers an ideal research environment for processing, analyzing, and modeling housing data sets. GIS offers powerful data mapping and visualization functionality to facilitate spatial explorations of the data. The source of data for this article was primary and was obtained using hand-held GPS. The article clearly shows the Global Positioning System (GPS) location and elevation of all the sampled housing estates in the study area and the first geo-referenced map of single family housing estates in Port Harcourt urban fringe area. This is very important for policy formulation because it enables researchers and policy analysts to evaluate the effectiveness of alternative policy tools for controlling undesirable spatial outcomes.

**Keywords:** GIS; Spatial mapping; Single Family Housing Estates; Urban Fringes

## Background to the Study

Housing development is one of the important functions currently seen in metropolitan cities. Certainly, housing development at metropolitan areas is not a recent phenomenon. The roots of this formation in developed countries, such as USA and England go back to 18<sup>th</sup> century when the first industrial cities were born. It diversified throughout time and reached today with its changed social and spatial features. Starting with 1980s, similar developments began to occur in Nigeria also, that broke the high density urban structure in a decentralized urban form (Abimbola, 2008). As a result, the housing development at metropolitan cities created some changes at these areas different from the ones in developed countries. One of these new residential form is “single family housing estate” that indicates to the new forms of urban growth and diffusion processes in metropolitan cities such as Lagos and Port Harcourt (Mabogunje, 2002).

When urban metropolitan cities are studied from the viewpoint of housing development, one of the most evident transformations in metropolitan areas in Nigeria after 1990 is escaping to peripheral areas from cities. Starting at the end of 1980s new housing areas began to form around the cities where people go to their offices at the city center in the morning and return back to their home in the evening (Mabogunje, 2002). These new housing areas got distant from cities in order to be nearer to the amenity and at the same time represented a tendency to choose location closer to major transportation routes where they could reach cities easily. Mostly they are “gated” and “packaged” environments with high prices and also appear as the most active part of housing market after 1990 particularly in Lagos, (Abimbola, 2008). This tendency which started to appear at the fringe areas of the metropolitan city of Port Harcourt has a fragmented developmental pattern, especially housing estates which spread alongside the major transportation routes of the city leading to changes in the scene of the current fringe areas, (Wizer, 2012).

Sequel to the above observation, since 1980s the rate of expansion of Port Harcourt city has been very rapid with attendant accelerated housing development at the current metropolitan fringe areas. Various reasons have been advanced for this phenomenal peripheral growth which ranges from increase in population arising from increased birth rate and migration, change in taste of residents due to change in educational and social status, congestion in the central business district (CBD) to the 1985 federal government order to oil companies to relocate their headquarters to Port Harcourt and Warri (Wizer, 2012).

The urban fabric of Port Harcourt metropolis has undergone dramatic changes during the last decades. From a colonial city clearly delineated in its historic boundaries, Port Harcourt has and continues to grow into the surrounding landscape, swallowing even more villages, coastlines, and previously unspoiled landscape, transforming into an ever increasing urban conglomerate. After 1980s, multi-center development of cities and its catalytic impact on reshaping of the economic landscape in metropolitan areas has drawn much attention (Hackworth, 2005). During the last quarter of the twentieth century, Port Harcourt experienced tremendous structural transformation due to population and economic growth and development of its transportation and communication systems and the impact of globalization (Johnson, 1994).

Rapid urban development and increasing land use changes due to increasing population and economic growth is being witnessed in Port Harcourt and cities in other developing countries. The measurement and monitoring of these land use changes are crucial to understand urban development dynamics over different spatial and temporal scales. Today, with rapid urbanization, there is increasing pressure on land particularly in the metropolitan cities. The cities are expanding in all directions resulting in large scale urban sprawl and changes in urban land use. The spatial pattern of such changes is clearly noticed on the urban fringes or city peripheral areas, than in the city centre. This has made the fringe area of the city to be the most dynamic landscape. In the modern age of urban expansion, 'fringe' is of much significance. The term 'fringe' suggests a border – line case between the rural and the urban and it actually lies on the periphery of urban areas, surrounding it and distinguishing it from the truly rural countryside.

The fringe of an urban complex forms a pattern depending upon the physiographic and transportation facilities of the area. Around major urban centres the physical expansion of built up areas beyond their municipal boundaries has been very conspicuous. As one moves out of a major city along the roads, one observes new residential colonies and a considerable amount of vacant land with partially developed residential land use. An important problem in the urban fringe area is the problem of land use. The pattern of land use in the area is dynamic and changes from rural land use to urban land use over short periods of time and distance.

The importance of location in the operation of housing is indisputable because housing is fixed in geographic space. The geographic location of a house determines access to employment, shopping, and recreation; neighbors and neighborhood characteristics; proximity to environmental amenities; and the level and quality of public services. Geographic location is a major determinant of household residential satisfaction and the resulting patterns of household mobility and neighborhood change. The process of location choice leads to geographic segmentation of the housing stock along various dimensions, including type, quality, ownership, and price, as well as along household characteristics, especially income, race and ethnicity, and lifestyles.

The importance of geographic location is inherent in many business practices concerning housing supply, marketing, and financing. Real estate practitioners know that location determines the premium that households are willing to pay for comparable properties. Appraisers take into account locational factors and recent sales in assessing the market value of properties. Mortgage lenders and insurers know that the geographic location of the property that secures a loan is a major determinant of their credit risk exposure.

Despite the recognized importance of geographic location for business, policy, and regulatory practices, its incorporation into housing research has been limited. An explicit spatial treatment is needed to measure and quantify

accurately the role of geographic location in housing studies. Although appropriate methods are available in spatial statistics to facilitate such treatment, there has been limited awareness of their availability in the housing research community. Only a few recent studies have applied spatial analytical tools to examine geographic location effects on housing choice and prices (Can 1990, 1992b; Can and Megbolugbe 1997; Dubin 1992; Pace and Gilley 1997), in population density models (Griffith and Can 1995), or in mortgage market outcomes (Anselin and Can 1995).

The lack of software tools, limited availability of accurate and comprehensive information on residential properties and location, and lack of research computing environments to facilitate the geo-processing needs of spatial data have further hindered the spatial treatment of housing mapping. Geographic Information Systems (GIS) technology is emerging as a significant contributor to overcome the operational impediments that hindered empirical work with a spatial focus. Today, high-end GIS research computing platforms offer an ideal environment for mapping single family housing estates and other housing types. GIS capabilities not only

facilitate the organization and management of geographic data, but they also enable researchers to take full advantage of locational information contained in these databases to support the application of spatial statistical tools. The combination of GIS research infrastructure and recent advances in spatial research thus offer tremendous opportunities for mapping single family housing estates in the study area which is the main thrust of this article.

To achieve this aim, the following two specific objectives were pursued:

1. Identify all the single family housing estates in Port Harcourt urban fringes.
2. Mapping of the locations and elevations of the single family housing estates

### **Study Area**

The study area, Port Harcourt urban fringe area is situated between longitude  $4^{\circ} 48''$  and  $5^{\circ} 00''$  N and latitude  $6^{\circ} 55''$  and  $7^{\circ} 10''$  E. The two Local Government Areas that make up the Port Harcourt urban fringe areas are Obio/Akpor and Eleme LGA's. They are the hub of industrial and commercial activities in the city, (Alagoa and Derefaka, 2001). The choice of Obio/Akpor and Eleme LGA's are strategic in this article because they constitute the current Port Harcourt metropolitan fringe area. Secondly single family housing estates can be found in these LGAs.

Like many cities in Nigeria, Port Harcourt has recorded rapid growth in population and aerial spread. From an estimated population of 500 in 1915 it grew to 30,200 in 1944. By 1963, its population was 179,563 and by 1973 it has reached 231, 532 persons. The Port Harcourt municipality's population was given as 440,399 by the 1991 national census. The 2006 national census show this population is more than a million (Obinna, Owei and Mark, 2010). In terms of its physical size, the city grew from 15.54 sq. km in 1914, to a metropolis covering an area of 360 sq. kilometers in the 1980s.

Urban development is denser on the corridors determined by geographic thresholds and major transportation connections. Port Harcourt as a result of population increase and economic growth spreads to the periphery as in the other metropolitan cities. However, this decentralization is not realized with an integral and regional planning but with patchwork of partial plans. This causes negative effects on urban environment, forests, fertile agricultural land and cultural values are threatened.

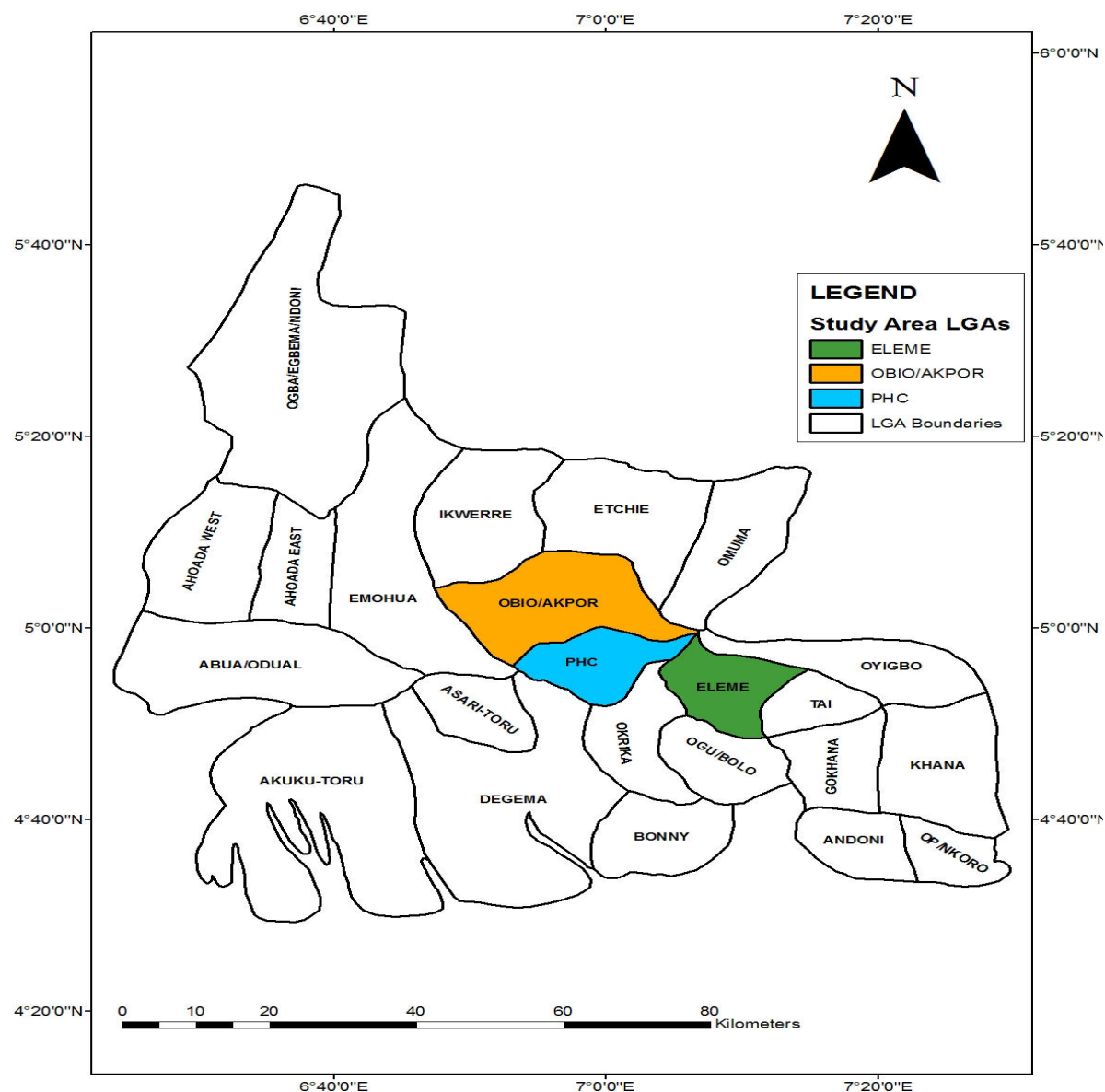
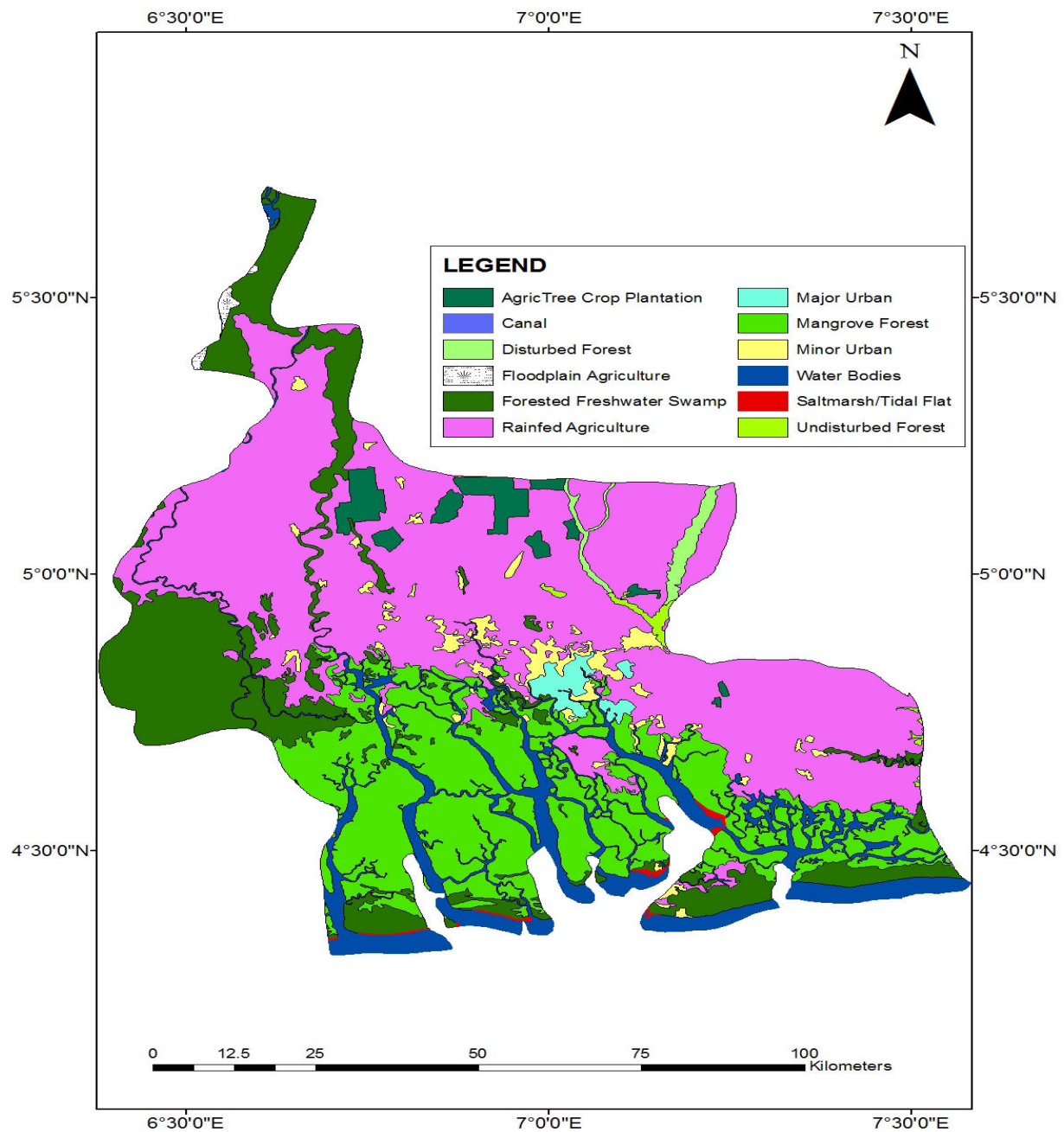


Figure 1. Map of Rivers State showing the Metropolis



**Figure 2. Map of Rivers State Showing Land Use**

### Methodology

The location and elevation of all the sampled estates which served as the primary data for this article were obtained using hand-held GPS. The entire population of this study comprises all settlements within the current Port Harcourt Metropolitan fringe area. All zones/neighbourhood in Obio/Akpor and Eleme LGA's formed the target population. Because of the difficulties involved in studying the target population, that is time and financial constraints, the study area was divided into five zones using stratified random sampling techniques. The basis for stratification is to enable us get the subset of the population.

The five zones were found to consist of thirty (30) single family Housing estates in all. They are as follows:

#### **ZONE A - WOJI ZONE**

1. Woji Housing Estate (60 Units)
2. Ognigba Palm Estate (30 Units)
3. Golden Valley Estate (90 Units)
4. Rumuogba Housing Estate (110 Units)
5. Rumuibekwe Housing Estate (60 Units)

#### **ZONE B - IRIEBE ZONE**

1. Laurel Heights Estate (120 Units; Not completed)
2. Tonimas Estate (60 Units)
3. Palm View City Estate (35 Units)
4. Iriebe Garden City Estate (40 Units)
5. Iriebe Housing Estate (40 Units)
6. Terra Wood Estate (42 Units)
7. Trinity Garden Estate (40 Units)

#### **ZONE C - ARTILLERY/RUMUIBEKWE ZONE**

1. Adamac Estate (35 Units)
2. Ekulema Gardens Estate (30 Units)
3. New Heaven Estate (110 Units)
3. Schlumberger Estate (30 Units)
5. Mini Ezekwu/ Cocaine Village (120 Units)
6. Agip Staff Estate (85 Units)
7. Total Village (60 Units)
8. Elekohia Housing Estate (120 Units)

#### **ZONE D - RUMUOKWURUSI/ELELENWO ZONE**

1. Shell Residential Estate (160 Units)
2. Eli-mini Igwe Heights (35 Units)
3. Elelenwo Housing Estate/Bristow (60 Units)
4. Deutag Camp Estate (30 Units)
5. Intels Aba Road Camp Estate (50 Units)
6. Lonestar Estate (30 Units)

#### **ZONE E - AKPAJO ELEME ZONE**

1. Akpajo Height Estate (60 Units)
2. Green Village (80 Units)
3. Intels Camp Estate (75 Units)
4. NNPC Estate (70 Units)

Geographic Information Systems (GIS) Programme (Arc View 9.9) was used for the mapping of the various single family housing estates location in the study area. This enabled us to get the Northings and Eastings as well as the elevation of all the sampled estates location.

#### **Results and Discussion**

The second objective of this study is the mapping of single family housing estates in the Port Harcourt metropolitan fringe area. Table 1 shows the GPS location and elevation of sampled single family housing estates in Port Harcourt urban fringe areas.

#### **Discussion of Results**

There is a need for emphasis on GIS geographic research as it indeed provides an ideal environment for conducting spatial research that would enable the researcher to organize, visualize, and analyze data in a map form. The visualization of geographic data familiarizes the researcher with the area of investigation and the underlying spatial context. GIS also provides the medium for the integration of multiple geographical data sets typically used in housing research, provides analytical support for spatial data analysis by providing explicit information on spatial relationships. The result of this article clearly makes GIS a very powerful analytical tool for spatial data analysis and modeling. It also reveals GIS as a Map maker and visualization aid. The common saying that “one picture is worth a thousand words” nicely conveys the importance of a map as a communicator of information. Evidence from the research showed that the first geo-referenced map of single family housing estates in Port Harcourt metropolitan fringe areas was achieved through the geo-spatial mapping of the study area.



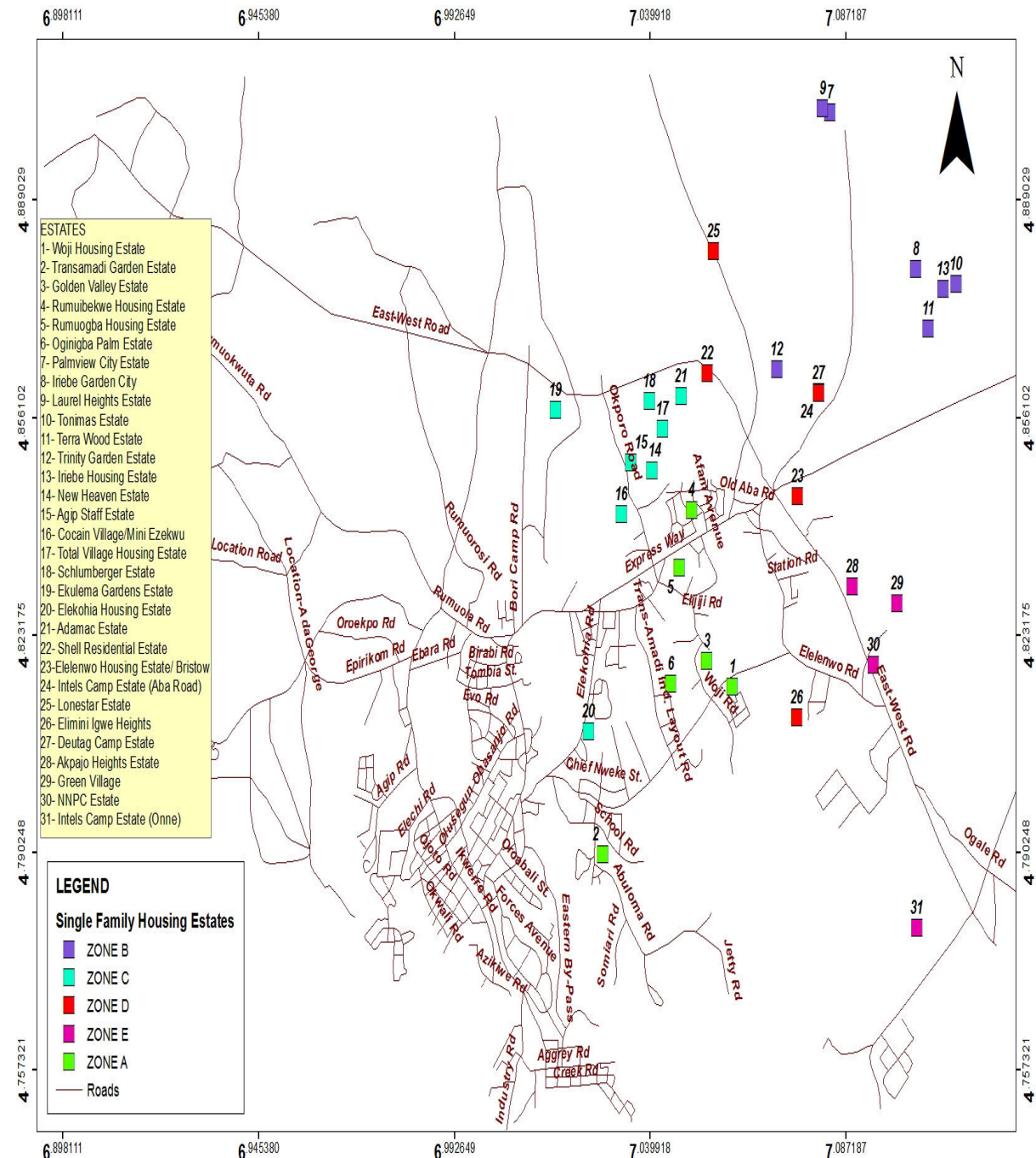
**TABLE 1. GPS Location and Elevation of Single Family Housing Estates**

ZONE	ESTATE	NORTHINGS (N)	EASTINGS (E)	ELEVATION (M)
A (Woji)	Woji Housing Estate	N 04° 48' 924"	E 007° 03' 582"	56.1m
A	Golden Valley	N 04° 49' 152"	E 007° 03' 208"	33.9m
A	Rumuibekwe Housing Estate	N 04° 50' 826"	E 007° 02' 999"	63.9m
A	Rumuogba Housing Estate	N 04° 50' 353"	E 007° 02' 268"	60.6m
A	Ognigba Palm Estate	N 04° 60' 443"	E 007° 02' 334"	45m
B (Iriebe)	Palm View City	N 04° 54' 133"	E 007° 04' 998"	68m
B	Iriebe Garden City	N 04° 52' 709"	E 007° 06' 241"	76.9m
B	Laurel Height	N 04° 54' 170"	E 007° 04' 890"	84m
B	Tonimas Estate	N 04° 52' 582"	E 007° 06' 826"	96m
B	Terra Wood	N 04° 52' 175"	E 007° 06' 415"	49.5m
B	Trinity Garden	N 04° 51' 800"	E 007° 04' 229"	88.3m
B	Iriebe Housing Estate	N 04° 52' 530"	E 007° 06' 631"	70m
C (Artillery)	New Heaven	N 04° 50' 887"	E 007° 02' 417"	78.8m
C	Agip Staff Estate	N 04° 50' 959"	E 007° 02' 115"	63.8m
C	Cocain Village	N 04° 50' 491"	E 007° 01' 980"	34.5m
C	Total Village	N 04° 51' 032"	E 007° 02' 379"	105.4
C	Schlumberger Estate	N 04° 51' 031"	E 007° 02' 378"	105.3m
C	Ekulema Gardens	N 04° 40' 620"	E 007° 02' 070"	43.2m
C	Adamac Estate	N 04° 45' 078"	E 007° 03' 306"	48.3m
C	Elekohia Housing Estate	N 04° 82' 158"	E 007° 02' 447"	20m
D (Elelenwo)	Shell Residential Estate	N 04° 51' 046"	E 007° 03' 013"	82.6m
D	Bristow Estate	N 04° 50' 648"	E 007° 04' 525"	87.4m
D	Intels Camp Estate (Aba Rd)	N 04° 51' 595"	E 007° 04' 836"	61.8m
D	Lonestar Estate	N 04° 52' 088"	E 007° 03' 306"	50.5m
D	Elimini Igwe Heights	N 04° 48' 640"	E 007° 04' 520"	86.2m
D	Deutag Camp Estate	N 04° 51' 590"	E 007° 04' 834"	61.4m
E (Eleme)	Akpajo Heights	N 04° 49' 827"	E 007° 05' 319"	37.2m
E	Green Village	N 04° 49' 677"	E 007° 05' 097"	72.2m
E	NNPC Estate	N 04° 49' 007"	E 007° 05' 629"	79.7m
E	Intels Camp Estate (Onne)	N 04° 43' 175"	E 007° 09' 418"	56.1m

Author's Field work, 2013

Table 1 above shows that the estate with the lowest elevation is Elekohia housing estate (20m) which is a major factor responsible for the perennial flooding of this single family housing estate. This is closely followed by Golden Valley estate (33.9m) which is located around the Wojí area of the Port Harcourt urban fringes.

The above GPS mapping of various Estates is further shown on **Figure 3** below:



**Figure 3. Map showing Single Family Housing Estates in Port Harcourt Metropolitan Fringe Areas**

## Conclusion

GIS in this context has greatly facilitated the spatial analysis of single family housing estates by offering an optimal research environment for exploiting the information content inherent in geographic data sets. As illustrated in table 1 and figure 3, the power of GIS for spatial analysis lies in the integrated research environment it offers for different stages of data analysis and modeling. GIS offers tremendous functionality for visualization of geographic data and greatly facilitates the organization and management of data through its spatial operators, such as spatial overlay and spatial comparisons. The contribution of GIS is especially



significant in this article especially in the area of data acquisition, preparation and constructing of variables on the basis of selected levels of spatial aggregation.

Finally, GIS provided the prerequisite locational and topological information for the spatial mapping, data analysis and modeling of the single family housing estates in this study. As research has shown, the incorporation of locational characteristics improves the precision of coefficient estimates and increases the predictive power of models (Can and Megbolugbe 1997). This is very important for policy formulation because it enables researchers and policy analysts to evaluate the effectiveness of alternative policy tools for controlling undesirable spatial outcomes. Hence, with the systematic mapping of the locations of single family housing estates in the study area, policy makers, land speculators, prospective residents, architects, builders and the general public can at a glance see the various estates and take appropriate decisions.

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